



Mathematical Critical Thinking Ability and Learner's Responsibility Character in Learning Cycle 7E with Scaffolding

Nanik Susilowati , Rochmad Rochmad , Ani Rusilowati

Universitas Negeri Semarang, Indonesia

Article Info

Article History:

Received :

10 January 2020

Accepted:

10 February 2021

Published:


30 June 2021

Keywords:

Critical Thinking Skills, Character of Responsibility, Learning Cycle 7E, Scaffolding

Abstract

This research aims to describe the critical thinking ability of mathematical and the character of the responsibility of learners in learning cycle 7E with scaffolding. This research is a type of research combined with concurrent embedded type. Data collection of critical thinking ability is done using the mathematical critical thinking ability test. The character data of responsibility is obtained from the results of the questionnaire of the character of responsibility. The results showed that the quality of LC7E learning with Scaffolding is (1) at the planning stage, the research instruments that had been compiled are valid, (2) at the implementation stage, had well-categorized learning results and get positive responses from learners, and (3) at the assessment stage, meet the effectiveness test. Also, learners with high responsibility characters can achieve six indicators of mathematical critical thinking ability, learners with moderate responsibility characters have varying mathematical critical thinking abilities that are capable of all six indicators of critical thinking ability and some were only capable at four indicators of mathematical critical thinking ability, while learners with low responsibility characters had not been able to achieve six indicators of mathematical critical thinking ability.

 Correspondence:

Kelud Utara III, Semarang, 50237, Indonesia

E-mail: nanik11wati@gmail.com

p-ISSN 2252-6455

e-ISSN 2502-4507

INTRODUCTION

Mathematics is a branch of abstract science so it takes understanding and solving real problems in mathematics teaching (Bayuningsih et al., 2018). Curriculum and learning objectives contain several mathematical skills, namely practicing logical, systematic, critical, creative, and careful and objective thinking in the face of an ever-changing future. The thought process that is considered quite important in learning mathematics is critical thinking. Because critical thinking is a systematic process that allows learners to formulate and evaluate their own beliefs and opinions (Hendriana et al., 2017).

Critical thinking can underlie individuals increasing their thinking potential through analysis of problems, problems, content, evaluation, and construction processes (Aksu & Koruklu, 2015). The description explains the importance of critical thinking ability for learners to have. However, the facts showed that the low mathematical ability of learners, especially critical thinking ability.

International surveys of PISA and TIMSS showed that learners' math achievement in Indonesia was lower than in other countries (Oktiningrum, 2016). According to previous research found that the cause of low PISA and TIMSS results is that learners were not used to solving math problems that require critical thinking skills (Nusyahidah & Albab, 2017). Low critical thinking ability is also caused by learning only emphasizes the application of simple formulas and procedures, it can cause the reasoning and logic of learners to be weak (Kusaeri, 2019). In other hand, learners become not encouraged to do problem-solving with various strategies (Simbolon et al., 2015).

The same problem occurred at SMPN 1 Todanan Blora. The result of an interview with one of the mathematics teachers showed that the learners in grade VIII were less active in participating in the learning. Learners are less motivated in following the learning. Learners receive materials and do problem exercises in books, so they are not used to solving problems that require critical thinking. If given a difficult question, the learners will give up and will not work because they cannot.

Learning quality is the level of achievement of the learning objectives. The achievement of this goal

is in the form of increased knowledge and skills and developing attitudes through the learning process (Daryanto, 2011). Three domains used to measure the learning quality according to Danielson (2011) were (1) Planning and preparation, (2) Classroom environment (implementation), and (3) Professional responsibilities (assessment).

The success of learners is not only seen from the results of learning achievements, but also from the character in following the learning. Syafitri (2017) explain that with character education it was expected that learners can independently improve and use their knowledge through character values that were realized in daily life. One of the important characters possessed by learners in learning is the character of responsibility because according to Aini, Sukestiyarno, & Waluya (2015) the character of responsibility has a positive effect on the mathematical ability of the learners. The character of responsibility is needed so that learners do not give up easily in solving problems that require learners to think critically (Prayogi & Widodo, 2017).

Supporting the success of learning in the classroom, teachers or lecturers should use the right learning model, varied, good teaching, and using good questions (Rochmad & Masrukan, 2016). Teachers need a learning model that can organize learners in learning. One of the appropriate learning models is learning cycle 7E because learning cycle 7E is a learning model centered on students so that learners can master the competencies to be achieved actively in learning (Rahmawati et al., 2019).

In addition to active learning models, scaffolding is also needed in learning. Scaffolding is an aid that allows learners to manage tasks independently, and assistance to bring learners to achieve competencies and complete tasks independently (Bakker et al., 2015). Scaffolding was provided by teachers or students who are more able to help learners think in solving problems (Paruntu et al., 2018).

Based on the description above, this research aims to describe the critical thinking ability of learners viewed from the character of responsibility in learning cycle 7E with scaffolding.

METHOD

This research uses a mixed-method, a combination of quantitative research and qualitative research. A mixed research method is a research approach that involves quantitative and qualitative data collection by combining two different forms of data and design merging, which can involve philosophical assumptions and theoretical frameworks (Creswell, 2016). The design of the mixed method used in this research is embedded concurrent.

The population in this research was learners of grade VIII SMP N 1 Todanan Blora in 2020/2021. Quantitative research uses class VIII subjects with class VIII F as control class and class VIII G, as experimental class. Experimental classes will be taught using a 7E learning cycle learning model with scaffolding. The learning steps are engage, explore, explain, elaborate, extend, exchange, and evaluate (Karagoz & Saka, 2015).

Class VIII F as a control class will be taught using an expository model. In qualitative research, the research subjects were determined by purposive sampling. The subject is taken from the experiment class based on the character of responsibilities. Those were two learners of high character of responsibility, two learners of medium character of responsibility, and two learners from low character of responsibility.

This research aims to find out the quality of learning consisting of planning, implementation, and assessment stages. To find out the quality of learning, at the planning stage is carried out a test of the validity of learning instruments with minimal categories of good. In the implementation stage, the observation of learning with a learning awareness sheet and the response of learners to learning minimally obtain an excellent category. The third stage or assessment stage, at this stage, will be carried out an effectiveness test to know the quality of learning. Learning is effective when the learner's learning outcomes are completed individually and classically, the average critical thinking ability of the learners in the experiment class is better than the average critical thinking ability of the learners in the control class, the proportion of mathematical critical thinking ability of the learners in the experiment class is better than the control class.

Qualitative research consisted of three stages, namely data reduction by selecting data used and discarding data not used in research, presentation of data by presenting test results of mathematical critical thinking ability and interview results, conclusion drawing/ verification in the form of new findings that previously did not exist.

RESULTS AND DISCUSSIONS

Learning quality in this study was measurement through three stages of learning quality. The planning stage is the validation of learning devices. The validation results of the learning device were as follows.

Table 1. Learning Device Validation

Instrument	Average	Criteria
Syllabus	4.15	Excellent
Lesson Plan	4.2	Very Excellent
Teaching Material	4.15	Excellent
Worksheet	4.3	Very Excellent
Mathematical critical thinking ability test	4.04	Excellent
Responsibility Character Questionnaire	4.1	Excellent
Interview Guidelines	4.1	Excellent

Based on the results in Table 1, it was known that validation of learning cycle 7E research instruments with scaffolding is valid and usable. The preparation of lesson plan in this research was based on the syllabus, with the syntax of learning cycle 7E with scaffolding that aims to improve the critical thinking ability of learners.

The implementation stage of this research was obtained data from the learning implementation sheet and the learners' response questionnaire. The results of learning observations obtained the following results.

Table 2. Observation of Learning Implementation

The x th meeting	Average	Criteria
1	4.27	Very Excellent
2	4.12	Excellent
3	4.23	Very Excellent

Based on the data presented in Table 2, the observation of learning implementation meets the minimum category of good. Then the data of learners' response to the implementation of learning showed a percentage of 76.8%. From the data obtained the results of learners responses to the implementation of learning are in a good category. So it can be concluded at the stage of the implementation of learning from the observations and responses of learners both in the good category.

The assessment stage was carried out an effectiveness test consisting of a completeness test and a different test. The results of the individual completion test using t-test with value are $t_{count} 7.60 > 1,698 t_{(0,95)}$, so it can be concluded that the learners are completed individually. Then the classical completedness test obtained a value of is $z_{count} 2.0412 > 1.64 z_{(0,45)}$ then H_0 rejected. Thus, it can be concluded that the proportion of learners who are taught using learning cycle 7E with scaffolding exceeds at least 75% of the completeness'.

Different test in this study, the average different test result is the value of t_{count} obtained is $t_{count} 2.89 > 1,669 t_{(0,95)}$, so the H_0 rejected. Thus, the average mathematical critical thinking ability of learners taught using 7E learning cycles by scaffolding is more than the mathematical critical thinking ability of learners who use expository. Then the different proportions test obtained the result that the value $z = 1.98643 > z_{0,5-\alpha} = 0.778$ then H_0 rejected. Thus, the proportion of students' mathematical critical thinking abilities using 7E learning cycles with scaffolding is better than the proportion of critical thinking abilities of learners who use expository learning.

The results of the effectiveness test that has been done showed that the effectiveness criteria at the evaluation stage were met. It was in line with Nugroho (2018) which stated that learners who are taught using learning cycle learning have higher math learning results than students who are taught with

conventional learning. Rusdi et al., (2018) also found that using the 7E learning cycle model, students can improve their critical thinking skills rather than using conventional learning models. Then the scaffolding strategy used in this study also affects the learning outcomes of learners, because there are significant differences in the mathematical ability of learners in the classroom who use scaffolding learning strategies with classes that use conventional learning (Sahal et al., 2018). In addition to the learning applied critical thinking ability is also influenced by the character of learners, one of which is the character of responsibility. It was in line with Nusantoro & Kurniawan (2014) the process of learning mathematics requires the responsibility shown by significant changes in the learning behavior of learners in order to obtain optimal learning outcomes. Other researchers namely Aini, Sukestiyarno, & Waluya (2015) also found that the positive impact arising from the character of responsibility towards a learners in terms of mathematical abilities.

The description of learner's critical thinking ability in this study was based on the level of character of responsibility. The character of responsibility referred to in this research is the responsibility of learners in participating in learning activities in schools. The character indicator of responsibility used in this study refers to Bacon's opinion. In this study, the character of responsibility is distinguished in three levels, namely high, medium, and low character of responsibility.

First level, there are learners with high characters of responsibility namely E10 and E16. Both subjects at the high level character of responsibility obtained TKBKM values above the complete limit of 93 and 82. Although both subjects have not yet achieved perfect grades, the student's work already contains all six indicators of critical thinking ability. It was in line with research results of Pasani et al., (2018); Pasani & Damayanti (2028) stated that the relationship character of responsibility and learning outcomes are categorized as quite strong, which means that if the character of responsibility of the learner is high then the learners learning outcomes are also high.

Second level, there are learners with medium character of responsibility namely E11 and E06. Both subjects at this level received grades 85 and 71. At

this level, the value of learners has also reached the complete limit. But at this level the problem of learners is different. Learners with high grades can solve problems and meet all six indicators of critical thinking ability, while those who obtain low solving problems do not meet the indicators of explanation and self-regulation. It was in line with the results of research by Aini, Sukestiyarno, & Waluya (2015) found that the character of responsibility has a positive effect on the mathematical ability of learners.

Third level there are learners with low responsibility characters namely subject E09 and subject E05. Both subjects got grades of 70 and 59, so some subjects exceeded the complete limit and some were below the complete limit. Solving the problem of mathematical critical thinking ability test learners at the low level of character of responsibility has not met all six indicators of critical thinking ability. Learners are only able to achieve three indicators of mathematical critical thinking ability. Learners with low character of responsibility, critical thinking ability is different from learners who have high and medium character of responsibility. It was in line with the research results of Parandika et al., (2019) that learners who have low character of responsibility has not been able to fulfill and carry out tasks properly so that it will affect the results of learning.

CONCLUSION

Conclusions obtained from the results of analysis and discussion were the quality of learning cycle 7E with scaffolding on the critical thinking ability of learners in grade VIII are in a good category with the following results: (1) at the planning stage, learning instruments are arranged valid and usable, (2) at the stage of implementation, the implementation of learning is in a good category and obtains good response from learners, (3) assessment stage, the results obtained meet the effectiveness test. Then learners with high character of responsibility can solve problems and meet the six indicators of mathematical critical thinking ability, namely interpretation, analysis, inference, evaluation, explanation, and self-regulation. Learners with the character of responsibility are doing a variety of problem solving, some learners solve the problem meet all six indicators of kirits thinking ability and

some are only able to achieve four indicators of critical thinking. Learners who have low character of responsibility only meet three indicators of critical thinking ability in solving the problem.

REFERENCES

- Aini, N. N., Sukestiyarno, S., & Waluya, B. (2015). Analisis Komunikasi Matematis dan Tanggung Jawab pada Pembelajaran Formulate Share Listen Create Materi Segiempat. *Unnes Journal of Mathematics Education Research*, 4(2), 115-121.
- Aksu, G., & Koruklu, N. (2015). Determination the Effects of Vocational High School Students' Logical and Critical Thinking Skills on Mathematics Success. *Eurasian Journal of Educational Research*, 59, 181-206.
- Bakker, A., Smit, J., & Wegerif, R. (2015). Scaffolding and Dialogic Teaching in Mathematics Education: Introduction and Review. *ZDM*, 47(7), 1047-1065.
- Bayuningsih, A. S., Usodo, B., & Subanti, S. (2018). Problem Based Learning with Scaffolding Technique on Geometry. *Journal of Physics: Conference Series*, 1013(1), 2-6.
- Creswell, J. W. (2016). *Research Design: Pendekatan Metode Kualitatif, Kuantitatif, dan Campuran*. Yogyakarta : Pustaka Pelajar.
- Danielson, C. (2011). *The Framework for Teaching Evaluation Instrument*. Princeton: The Danielson Group.
- Daryanto. (2011). *Media Pembelajaran*. Bandung: Satu Nusa.
- Hendriana, H. Rohaeti, E. E., & Sumarmo, U. (2017). *Hard Skill dan Soft Skill Matematika Siswa*. Bandung: PT Refika Aditama.
- Karagoz, Ö., & Saka, A. Z. (2015). Development of Teacher Guidance Materials Based on 7E Learning Method in Virtual Laboratory Environment. *Procedia-Social and Behavioral Sciences*, 191, 810-827.
- Kusaeri, K. (2019). Pedagogical Beliefs about Critical Thinking among Indonesian Mathematicspre-service Teachers. *International Journal of Instruction*, 12(1), 573-590.

- Nugroho, H. (2018). Pengaruh Model Pembelajaran Learning Cycle 5e terhadap Hasil Belajar Matematika. *Histogram*, 2(1), 45-58.
- Nursyahidah, F., & Albab, I. U. (2017). Investigating Student Difficulties on Integral Calculus Based on Critical Thinking Aspects. *Jurnal Riset Pendidikan Matematika*, 4(2), 211-218.
- Nusantoro, E., & Kurniawan, K. (2014). Meningkatkan Tanggung Jawab Belajar Melalui Layanan Penguasaan Konten. *Indonesian Journal of Guidance and Counseling: Theory and Application*, 3(3), 44-50.
- Oktiningrum, W. (2016). Developing PISA-" Like" Mathematics Task with Indonesia Natural and Cultural Heritage as Context to Assess Students Mathematical Literacy. *Journal on Mathematics Education*, 7(1), 1-10.
- Parandika, R. W., Muhtarom, M., & Sutrisno, S. (2019). Analisis Karakter Disiplin dan Tanggung Jawab Siswa pada Proses Pembelajaran Matematika Kelas XI SMK Palebon Semarang. *Imajiner: Jurnal Matematika dan Pendidikan Matematika*, 1(6), 364-372.
- Paruntu, P. E., Sukestiyarno, Y. L., & Prasetyo, A. P. B. (2018). Analysis of Mathematical Communication Ability and Curiosity through Project Based Learning Models with Scaffolding. *Unnes Journal of Mathematics Education Research*, 7(1), 26-34.
- Pasani, C. F., & Damayanti, F. (2018). Penerapan Model Pembelajaran Group Investigation dalam Pembelajaran Matematika untuk Membina Karakter Kreatif dan Tanggung Jawab. *Jurnal Pendidikan Matematika*, 6(1), 1-9.
- Pasani, C. F., Kusumawati, E., & Imanisa, D. (2018). Penerapan Model Pembelajaran Kooperatif Tipe Scramble dalam Pembelajaran Matematika untuk Membina Karakter Tanggung Jawab dan Disiplin Siswa. *Jurnal Pendidikan Matematika*, 6(2), 178-188.
- Prayogi, A., & Widodo, A. T. (2017). Kemampuan Berpikir Kritis Ditinjau dari Karakter Tanggung Jawab pada Model Brain Based Learning. *Unnes Journal of Mathematics Education Research*, 6(1), 89-95.
- Rahmawati, A., Kartono, K., & Hidayah, I. (2019). Algebraic Thinking Ability Based on Mathematics Disposition in Learning Cycle 7E Model. *Unnes Journal of Mathematics Education Research*, 8(1), 18-24.
- Rochmad, R., & Masrukan, M. (2016). Studi Kinerja Mahasiswa dalam Menganalisis Materi pada Pembelajaran Kooperatif Resiprokal. *Kreano, Jurnal Matematika Kreatif-Inovatif*, 7(1), 47-57.
- Rusdi, A. I., Kosim., & Hikmawati. (2018). Rusydi, A. I., Hikmawati, H., & Kosim, K. (2018). Pengaruh Model Learning Cycle 7E terhadap Kemampuan Berpikir Kritis Peserta Didik. *Jurnal Pijar Mipa*, 13(2), 124-131.
- Sahal, M., Irianti, M., & Sari, N. (2018). Penerapan Strategi Pembelajaran Scaffolding untuk Meningkatkan Pemahaman Konsep Peserta Didik pada Materi Momentum, Impuls dan Tumbukan Kelas X SMA N 12 Pekanbaru. *JOM FKIP*, 5(2), 1-10.
- Simbolon, M., Surya, E., & Syahputra, E. (2017). The efforts to Improving the Mathematical Critical Thinking Student's Ability Through Problem Solving Learning Strategy by Using Macromedia Flash. *American Journal of Educational Research*, 5(7), 725-731.
- Syafitri, R. (2017). Meningkatkan Tanggung Jawab Belajar Melalui Strategi Giving Questions and Getting Answers pada Siswa. *Jurnal Penelitian dan Pengembangan Pendidikan*, 1(2), 57-63